UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

OCT 22 2002

In Reply Refer To:
SWR-01-SA-5661:FKF

Mr. Tom Cavanaugh
Chief, Sacramento Valley Office
U. S. Army Corps of Engineers
Regulatory Branch
1325 J Street
Sacramento, California 95814-2922

Dear Mr. Cavanaugh:

This document transmits the National Marine Fisheries Service's (NOAA Fisheries) biological opinion (Enclosure 1) based on our review of the proposed Clover Valley Lakes development project (1999001279) located in the City of Rocklin, Placer County, California, and its effects on threatened Central Valley steelhead (*Oncorhynchus mykiss*) in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 USC 1531 *et seq.*). Also, as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended (16 U.S.C. 1801 *et seq.*), NOAA Fisheries' Essential Fish Habitat (EFH) Conservation Recommendations for Pacific coast salmon, which may be affected by the proposed action, is enclosed (Enclosure 2). Your October 4, 2001, request for formal consultation was received on October 9, 2001.

This biological opinion is based on information provided in the August 2002 (Revised) Draft Environmental Impact Report (DEIR), a prior DEIR dated September 1995; the Final Environmental Impact Report (FEIR) dated August 1996; site visits by F. Kelly Finn of NOAA Fisheries and the project applicant's representatives on August 16, 2001, and January 3, 2002; written correspondence and phone conversations; and meetings between NOAA Fisheries staff and the applicant's representatives on January 3, 2002. The complete administrative record for this consultation is maintained at the NOAA Fisheries Sacramento Area Office.

Endangered Species Act Consultation

Based on the best available scientific and commercial information, NOAA Fisheries concludes that the proposed project is not likely to jeopardize the continued existence of Central Valley steelhead.

An Incidental Take Statement is included with the biological opinion that identifies Reasonable and Prudent Measures and Terms and Conditions to implement those measures, to ensure that the impacts of any incidental take are minimized.

Consultation with NOAA Fisheries must be reinitiated if (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals that the project may affect listed species in a manner or to an extent not previously considered; (3) the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed, or critical habitat is designated that may be affected by the project.

Essential Fish Habitat Consultation

NOAA Fisheries has provided four (4) EFH Conservation Recommendations for Pacific salmon. The Army Corps of Engineers (Corps) has a statutory requirement under section 305(b)(4)(B) of the MSFCMA to submit a detailed response in writing to NOAA Fisheries that includes a description of measures proposed for avoiding, mitigating, or offsetting the impact of the activity on EFH, as required by section 305(b)(4)(B) of the MSFCMA and 50 CFR 600.920(j) within 30 days. If unable to complete a final response within 30 days of final approval, the Corps should provide NOAA Fisheries an interim written response within 30 days. The Corps should then provide a detailed response.

If you have any questions about this consultation please contact Ms. F. Kelly Finn in our Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, CA 95814. Ms. Finn may be reached by telephone at (916) 930-3600 or by Fax at (916) 930-3629.

Sincerely,

for Rodney R. McInnis
Acting Regional Administrator

Enclosures

cc: NOAA Fisheries-PRD, Long Beach, CA
Stephen A. Meyer, ASAC, NOAA Fisheries, Sacramento, California
Demar Hooper, Taylor, Hooper & Wiley, 2870 Gateway Oaks Drive, Suite 200, Sacaramento, California 95833

Enclosure 1

BIOLOGICAL OPINION

AGENCY: U. S. Army Corps of Engineers, Sacramento District

ACTIVITIES: Section 404 Permit Application for Clover Valley Lakes development project

CONSULTATION CONDUCTED BY: NOAA Fisheries Service/Southwest Region

DATE ISSUED: OCT 22 2002

I. CONSULTATION HISTORY

On October 4, 2001, the National Marine Fisheries Service (NOAA Fisheries) received a written request for formal consultation from the U.S. Army Corps of Engineers (Corps) for issuance of a Department of Army permit for the Clover Valley Lakes project. After reviewing the information provided by the Corps, NOAA Fisheries requested additional information necessary to complete the consultation on December 20, 2001. On January 3, 2002, a meeting was held between personnel from NOAA Fisheries, the project applicant, environmental consultants, and the applicant's legal representative. The meeting was followed by a site visit attended by a NOAA Fisheries biologist and water quality specialist and the applicant's representatives. On the site visit and during the preceding meeting NOAA Fisheries described our concerns and the project applicant proposed minor changes to the project description. On January 8, 2002, additional information and a description of changes to the project were provided to NOAA Fisheries by the project applicant. In April 2002, the Corps informed NOAA Fisheries that the applicant's existing permit may be invalid and consultation was suspended as the project description may have changed. The existing Nationwide permit granted for this project in 1999 is no longer valid and an application for current Department of Army, Section 404 permit was submitted on August 20, 2002. NOAA Fisheries received the Department of Army permit application filed on August 20, 2002 and a copy of the Draft Environmental Impact Report (dated August 2002) on August 22, 2002. On August 29, 2002, two updated maps showing the proposed buffer zone were delivered to NOAA Fisheries.

This biological opinion is based on information provided in the Draft EIR (DEIR) dated September 1995; the Final Environmental Impact Report (FEIR) dated August 1996; site visits by F. Kelly Finn of NOAA Fisheries and the project applicant's representatives on August 16, 2001, and January 3, 2002; written correspondence and phone conversations between F. Kelly Finn and B. Demar Hooper, the project applicant's representative; and meetings between F. Kelly Finn and Joe Dillon of NOAA Fisheries, and the applicant's representatives on January 3, 2002. The complete administrative record for this consultation is maintained at the NOAA Fisheries, Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, California, 95814.

II. DESCRIPTION OF THE PROPOSED PROJECT

The Corps proposes to issue a Department of Army Nationwide permit 26 (NWP) for activities associated with construction of a development project on a 622-acre project site located within the City of Rocklin, in the County of Placer. The proposed development site is bisected by Clover Valley Creek and lies within an approximate 1,940-acre watershed. The site is relatively flat to steeply sloping and is characterized by the north-south oriented, "U" shaped valley with the creek flowing through the center and bordered by extensive wetlands. The NWP would authorize the impact of 2.56 acres of permanent fill within identified riparian or seasonal wetland areas. The proposed development on the 622-acre site would include construction of approximately 800 homes, five acres of commercial development, 32.5 acres of major roadways including five separate stream crossings, and a meandering bike trail. The project would also result in removal of approximately 3,963 oak trees and eventual development of home lots that are in or immediately adjacent to the riparian or seasonal wetlands along Clover Valley Creek. Also included as part of the project is approximately 190 acres of open space primarily in upland areas too steep to build on and a park encompassing about 6.7 acres.

Stream Crossings

The three upstream crossings are proposed as culverts sized to accommodate a 100-year flood event and will not provide any detention. Each of the three upstream crossings is designed to have two culverts with natural bottoms. One culvert would be designed to convey normal summer flows and up to a ten-year storm event. This culvert invert will be positioned to match the existing elevation conditions of the creek. The second culvert would be with a slightly elevated invert and be sized to provide additional capacity conveyance to for a 100-year storm event.

The two downstream crossings would be designed to provide for detention by constructing a weir structure at each of the two locations. Each crossing would have a single culvert at the stream channel elevation to convey runoff from up to a 10-year storm event similar to the upstream crossings. Runoff from flow events greater than the 10-year flood event would be retained by a concrete headwall structure containing the double culverts. A detention area, for flood control purposes, would be created by setting the weir elevation based on detention requirements that would provide a backwater area. Construction options for the culverts and weirs are being evaluated. The applicant proposes to use reinforced soil in creating the roadway fills with precast concrete culverts used in the crossings. In addition, they propose to address potential scour and erosion control upstream and downstream of the culvert locations, however, specific details were not provided.

Roadways

The proposed development would include construction of three major roads and other smaller streets throughout the site comprising approximately 32.5 acres. Two of the major roads (Summit Drive west of the creek and Wild Ginger Loop to the east) would be constructed from north to south through the valley adjacent to the creek channel and connected to each other by the stream crossings. The valley this project site is located within has fairly steep slopes which presents difficulties when designing another major arterial, Clover Valley Parkway, that would connect this new subdivision with Sierra College Boulevard to the east and with the existing Whitney Oaks subdivision located westward and at a higher elevation to Clover Valley. The proposed Summit Drive, located west of the creek, abuts the creek and its riparian corridor. Table 1 lists measurements along a centerline of the creek, at 500-foot intervals, of the buffer width. They range from a zero foot buffer from the edge of the creek channel to 663 feet with an average buffer width of 57 feet on the west side and 118 feet on the east.

Stormwater

As described in the stream crossings section, large storm flow events would be retained behind the two downstream crossing's double culvert structure concrete headwall. The project is required to address sediment as part of post-development design in addition to during the construction phase. The stormwater system will collect runoff which will be conveyed through an oil/grit separator and/or sediment system to intercept sediment prior to its discharge into Clover Valley Creek. The lots facing and abutting the creek will be graded to drain into the street system or be collected in a rear yard drainage system with both receiving treatment through an oil/grit separator prior to discharge. The twenty-seven proposed oil/grit separators are designed to intercept oils, floatables (plastic bottles, cans, etc.), and other potentially harmful elements prior to release into the creek.

The applicant has also proposed to install driveway filter strips composed of permeable pavement strips at the bottom of residential driveways which would allow some potential stormwater runoff to infiltrate rather than running into the road network.

Action Area

An action area is defined as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action" (50 CFR 402.02) For the purposes of this Opinion, the action area includes the Clover Valley Creek watershed from the uppermost extent of the project site downstream to the confluence with Antelope Creek, and downstream Antelope Creek to the Dry Creek confluence.

III. STATUS OF THE SPECIES

This biological opinion analyzes the effects of the Clover Valley Lakes Project on threatened Central Valley steelhead (*Oncorhynchus mykiss*).

Central Valley Steelhead—Threatened: Population Trends, Life History, and Biological Requirements

Effective May 18, 1999, NOAA Fisheries listed the Central Valley steelhead evolutionarily significant unit (ESU) as threatened under the ESA (63 FR 13347). Central Valley steelhead once ranged throughout most of the tributaries and headwaters of the Sacramento and San Joaquin river basins prior to the dam construction and watershed development of the 19th and 20th centuries (McEwan and Jackson 1996). Historical documentation shows that steelhead were once widespread throughout the San Joaquin River system (CALFED 1999). In the early 1960s, the California Fish and Wildlife Plan estimated a total run size of about 40,000 adults for the entire Central Valley and San Francisco Bay (California Department of Fish and Game 1965). The annual run size for this ESU in 1991–1992 was probably fewer than 10,000 fish, based on dam counts, hatchery returns, and past spawning surveys (McEwan and Jackson 1996).

Estimates of historical habitat for steelhead can be based on estimates of historical habitat for chinook salmon. Habitat loss for steelhead, however, is probably greater than habitat loss for salmon, because steelhead ascend higher into the drainages than do chinook salmon (Yoshiyama *et al.* 1996). Clark (1929) estimated that originally there were 6,000 miles of salmon habitat in the Central Valley system and that 80% of this habitat had been lost by 1928; the basis for Clark's estimate is not known. Yoshiyama et al. (1996) calculated that roughly 2,000 miles of salmon habitat was actually available before dam construction and mining and concluded that 82 percent of what was present is not accessible today.

Impassable dams block access to most of the historical headwater spawning and rearing habitat of Central Valley steelhead. In addition, much of the remaining accessible spawning and rearing habitat is severely degraded by elevated water temperatures, agricultural and municipal water diversions, unscreened and poorly screened water intakes, restricted and regulated streamflows, levee and bank stabilization projects, and poor quality and quantity of riparian and shaded riverine aquatic (SRA) cover (Busby *et al.* 1996). Reynolds *et al.* (1993) reported that 95 percent of salmonid habitat in California's Central Valley has been lost, mainly due to mining and water development activities. They also noted that declines in Central Valley steelhead stocks are due mostly to water development resulting in inadequate flows, flow fluctuations, blockages, and entrainment into diversions.

At present, wild steelhead stocks appear to be confined mostly to upper Sacramento River tributaries, such as Antelope, Deer, and Mill Creeks and the Yuba River (McEwan and Jackson 1996). However, the presence of naturally spawning populations appears to correlate well with the presence of fisheries monitoring programs, and recent implementation of new monitoring efforts has found steelhead in streams previously thought not to contain steelhead populations, such as Auburn Ravine and Dry Creek. It is possible that other naturally spawning populations exist in Central Valley streams but have not been detected because of the lack of monitoring or research programs (IEP Steelhead Project Work Team 1999).

Adult steelhead migrate upstream in the Sacramento River mainstem from July through March, with peaks in September and February (Bailey 1954, Hallock et al. 1961). The timing of upstream migration is generally correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures. The preferred temperatures for upstream migration are between 46 degrees Fahrenheit (°F) and 52°F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986). Unusual stream temperatures during upstream migration periods can alter or delay migration timing, accelerate or retard migrations, and increase fish susceptibility to disease. The minimum water depth necessary for successful upstream passage is 18 centimeters (cm) (Thompson 1972).

Spawning may begin as early as late December and can extend into April with peaks from January through March (Hallock et al. 1961). Steelhead spawn in cool, clear streams that have suitable gravel size, depth, and current velocity. Intermittent streams may be used for spawning (Barnhart 1986, Everest 1973). Gravels 1.3–11.7 cm in diameter (Reiser and Bjornn 1979) and flows of approximately 40–90 cm/second (Smith 1973) generally are preferred by steelhead. Reiser and Bjornn (1979) reported that steelhead prefer a water depth of 24 cm or more for spawning. The survival of embryos is reduced when fines of less than 6.4 millimeters (mm) comprise 20–25 percent of the substrate. Studies have shown that embryo survival improves when intragravel velocities exceed 20 cm/hour (Phillips and Campbell 1961, Coble 1961). The preferred temperatures for spawning are between 39°F and 52°F (McEwan and Jackson 1996).

The length of time required for eggs to develop and hatch depends on water temperature and is quite variable; hatching varies from about 19 days at an average temperature of 60°F to about 80 days at an average of 42°F. The optimum temperature range for steelhead egg incubation is 46°F to 52°F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986, Leidy and Li 1987). Egg mortality may begin at temperatures above 56°F (McEwan and Jackson 1996).

After hatching, pre-emergent fry remain in the gravel, living on yolk-sac reserves for another 4–6 weeks, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954). Upon emergence, steelhead fry typically inhabit shallow water along perennial streambanks. Older fry establish territories that they defend. Streamside vegetation is essential for foraging, cover, and general habitat diversity. Steelhead juveniles are usually associated with the bottom of the stream. In winter, they become inactive and hide in available cover, including gravel or woody debris. The majority of steelhead in their first year of life occupy riffles, although some larger fish inhabit pools or deeper runs. Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. After spending 1–3 years in fresh water, juvenile steelhead migrate to the ocean. Barnhart (1986) reported that steelhead smolts in California range in size from 14 to 21 cm (fork length). Hallock et al. (1961) found that juvenile steelhead in the Sacramento Basin migrate downstream during most months of the year, but the peak period of emigration occurs in the spring, with a much smaller peak in the fall.

Steelhead usually spend 1–2 years in Central Valley and Delta waters and 1–4 years in the ocean before returning to their natal streams to spawn (Barnhart 1986, Busby et al. 1996). Juvenile survival in fresh water relies on suitable conditions which include hydraulic and structural complexity; pool and off-channel habitats used for rearing and refugia; production of aquatic invertebrates which serve as a prey base; and water which is cool, has sufficient oxygen, and is free of pollutants (Spence et al. 1996). Young steelhead also require sufficient flow to maintain optimal water quality and passage which is free of barriers.

Habitat alterations can affect predation rates by altering water flow, temperature, or velocity which may favor certain piscivorous fishes (Spence et al. 1996). In the Central Valley, habitat modification has resulted in elevated water temperatures and creation of slow-moving pools which has allowed many non-native piscivores to thrive in valley streams. These exotic species, such as small-mouth and large-mouth bass, striped bass, and others may be extensively preying on young salmonids.

Riparian vegetation greatly influences the biological and physical processes that provide freshwater habitat for salmonids. These processes include shade and cover, water quality and flow routing, the aquatic food web, sediment routing and composition, stream channel bedform and stability, and linkages to the floodplain (Beschta 1991, Gregory *et al.* 1991, Schlosser 1991, Sullivan *et al.* 1987). Nearshore areas provide valuable attributes for rearing and migrating juvenile salmonids including: (1) banks composed of natural, eroding substrates supporting riparian vegetation that either overhangs or protrudes into the water; (2) water containing variable amounts of woody debris, such as leaves, logs, branches, and roots, and often substantial natural detritus; and (3) variable water velocities, depths, and flows. In-water cover, from downed branches or trees or overhanging vegetation and irregular banks, enhances the diversity of the stream habitat and provides juvenile salmonids many opportunities for feeding and protection from predators.

The gradual and continuous loss of mature riparian habitat through levee and bank protection activities leads to lower stream productivity and increased homogeneity of the nearshore areas. Large areas that lack riparian vegetation limit the viability of the stream to support anadromous fish. Studies have shown high preference of juvenile salmon for natural shoreline areas, indicating that continued loss of riparian habitat could hinder the successful rearing of juvenile salmonids (U.S. Fish and Wildlife Service 1993).

IV. ENVIRONMENTAL BASELINE

Status of the Listed and Proposed Species in the Action Area

Clover Valley Creek flows into Antelope Creek which flows into Secret Ravine which becomes Dry Creek at its downstream end. California Department of Fish and Game (CDFG) letters and reports dating back to 1965 indicate the presence of chinook salmon runs within the Dry Creek drainage (CDFG 1965, 1972, 1989) and some reports also indicate the presence of rainbow trout (CDFG 1972, CDFG 1975) within the watershed. These fish may have been anadromous steelhead, however, no type analysis was done at the time of capture. According to annual field surveys conducted by the Dry Creek Conservancy, primary spawning streams for both species within the drainage are Secret Ravine and Miner's Ravine, which flow into Dry Creek downstream of Clover Valley Creek.

The City of Roseville has been monitoring Linda and Cirby Creeks, tributaries to Dry Creek for several years. During the 1998/1999 surveys in Linda Creek one steelhead was observed. During the 2001 season 40 adult chinook were observed and no steelhead, however, Cirby and Linda creeks have the most impact from urban development and encroachment of all Dry Creek tributaries. CDFG stream evaluation surveys found juvenile steelhead in Secret Ravine ranging from 21-310 mm FL and averaging 117 mm FL ($n = 58$). CDFG found daily mean water temperatures in the low elevation valley stream environment to be excessive during summer ($\geq 80\,^{\circ}$F), however, the foothill and headwater environment of the creek at higher gradient did have suitable over-summering temperatures ($\leq 70\,^{\circ}$F).

Clover Valley Creek may provide suitable over-summering temperatures if access was restored to upstream areas by replacing culverts. CDFG also found steelhead present in Miners Ravine, another tributary to Secret Ravine, in the Dry Creek watershed. The CDFG report concluded by recommending measures to improve habitat which included:(1) identify, control, and prevent sources of sediment pollution, and (2) protect water quality by discouraging land-use practices that favor production of warmwater fishes, i.e. increased water temperatures and decreased level of dissolved oxygen (R. Titus, CDFG 2001). There are no available fisheries surveys of Clover Valley creek, however, CDFG staff have stated that there are historic accounts of salmon in the creek (J. Nelson, CDFG, pers.comm.) which indicates steelhead may have historically used the creek as well. There are reports of rainbow trout/steelhead or salmon being sighted all along the length of Clover Valley Creek (D.Bennett, Ecologic Engineering; pers.comm.). Another report describes salmon attempting to migrate past the culvert at Argonaut Road (M. Jasper, Sierra Club; pers.comm.).

Factors Affecting Species Environment within the Action Area

Residential and industrial development over the last 30 years have resulted in degraded instream habitat conditions throughout the Dry Creek drainage. Stream channels, including spawning areas, have been compacted or silted-in to such an extent that spawning production has been identified within limited areas of only one or two tributaries. Development along the creeks has exacerbated peak and high flow conditions, resulting in increased flooding in downstream areas, such as within the City of Roseville. In response, bank stabilization and flood control projects have been installed, resulting in permanent changes to instream and near stream habitats. Summer flow conditions in the lower drainage, have changed due to releases from the City of Roseville's Wastewater Treatment Plant. Downstream low flow temperature conditions preclude over-summering by salmonids in the drainage. However, it is unknown what temperatures chinook and steelhead within the Dry Creek drainage are adapted to tolerate. There is ongoing restoration activities within the Dry Creek watershed, on Miners Ravine, Secret Ravine, and Dry Creek. They include actions to plant riparian vegetation, restore floodplain habitat, gravel supplementation, barrier removal, and stabilize banks. These activities are contributing to increasingly the quality of salmonid habitat throughout the watershed which may encourage more steelhead to utilize the creeks in the future.

There is excellent riparian canopy cover throughout most of Clover Valley Creek in the project area. However, a golf course constructed downstream near the confluence with Antelope Creek has likely resulted in a migration barrier to fish. A road crossing at the golf course includes a protruding or 'shotgun' culvert which most likely does not allow for upstream passage past this point. However, it is likely that winter high flows may overtop the road at this crossing and adult salmonids would be able to ascend upstream avoiding the culvert altogether. The creek is considered restorable because the 'problem culvert' could be easily replaced and full passage restored. Overall, the action area was likely suitable for opportunistic use which may have included spawning by salmonids when water temperatures and flow conditions were appropriate prior to construction of the barrier. Such drainages have historically contributed to continued survival of steelhead, which are variable enough in their life history to utilize streams that have unstable flow regimes and may become intermittent in some years. Within the project site itself Clover Valley Creek meanders and connects with large areas of wetlands which function to protect water quality and dissipate storm flows, which also would contribute to habitat quality for steelhead.

V. EFFECTS OF THE ACTION

Conversion of the approximate 622-acre valley from open space consisting of wetlands, oak woodlands, and grasslands to impervious space including an extensive network of roads, five stream crossings, and hundreds of residential dwellings would impact the integrity of the aquatic and riparian corridor. The dominant mechanisms would include reduction in canopy cover due to the proximity of the road to the creek corridor and the stream crossings, alteration in storm water quantity and quality inputs into the stream, reduction in wetlands acreage on the site which diminishes the functioning capacity of the wetlands such as sediment collection and water filtration, and overall encroachment on the riparian and aquatic habitat of Clover Valley Creek as open space is replaced with roads and houses, and an intact creek corridor is replaced with one where a road abuts up against the riparian vegetation and culverts are installed at five crossings.

Replacement of open space, such as the oak woodlands, grassy areas, and wetlands, with impervious surfaces would greatly reduce water infiltration and would alter the routing and storage of water in the basin. Winter storm precipitation would no longer infiltrate the ground on the entire site but rather would rapidly run off all roads, rooftops, and other impervious surfaces. Results on the ground could include increased peak flows, channel erosion, landslides, pollution entering the creek, and accelerated channelization (Spence *et al.* 1996). The riparian corridor would likely, over time, become restricted with construction of roads parallel to the wetted channel and as a result of adjacent backyards. Routing of storm water into the channel, rather than gradually infiltrating into the soil, results in a more episodic flow regime with higher peak flows and reduced base flows (Spence *et al.* 1996).

Impacts to the Riparian Corridor

The proposed project includes construction of two roads which parallel the creek and five creek crossings. The road proposed on the west side of the creek includes sections of road where there is essentially no buffer from the creek edge (zero-foot buffer)(see Table 1). Because of the steep slopes along the west and east of the valley bottom, the road cannot be easily moved back from the creek to provide a suitable buffer. Fish-bearing streams are influenced by conditions of upstream reaches, including ephemeral and perennial non fish-bearing streams (Spence *et al.* 1996). The establishment of riparian buffer zones is generally accepted as the most effective way of protecting aquatic and riparian habitats (Cummins *et al.* 1994). In order to protect the riparian corridor and aquatic system's functioning capacity, there would need to be a sufficient 'no-build' riparian buffer along Clover Valley Creek. The buffer would protect water quality, protect water temperature from increased solar radiation, provide a source of large woody debris and nutrient input, protect the creek banks from erosive forces, and filter out pollutants and sediment inputs. There are differing opinions as to the size of a riparian setback necessary to protect the riparian and aquatic resource, however, the majority of studies recommend a buffer that is at a minimum equal to one-half to one site tree potential height (FEMAT 1993 *in* Spence *et al.* 1996).

Very few studies have examined the effectiveness of buffers in filtering runoff from urban areas. One study examined urban runoff in North Carolina and found that buffers of 22.9 meters (75.1 ft.) as required for estuarine shorelines were inadequate for reducing nitrogen, phosphorus, and biochemical oxygen demand (BOD) of runoff from residential areas (Phillips 1989 *in* Spence *et al.* 1996). Although we may not have exact information as to the required buffer size to completely avoid any impacts to the riparian and aquatic system, it is logical to assume that 'no buffer' is inadequate. According to Table 1 which lists 19 measured points from the edge of the creek to the proposed road (=buffer distance), on the west side of the creek 42% of the measured points have a buffer distance less than 50' and 74% have a buffer less than 75', and on the east side of the creek 47% of the points have a buffer less than 50' while 58% are within a 75' buffer. The buffer distances represented by the measured points measured at 500 ft. intervals indicate that the roads which follow the contour of Clover Valley Creek is proposed to be located mostly less than 75' from the creek's edge on both sides, and often within 50 feet. Over time, this would also limit the ability of the creek to migrate naturally within the floodplain and could lead to channelization of the creek flow. Channelized flow would cause downcutting and erosion, and could over time lead to degradation of the riparian corridor. This could cause increased sediment and elevated water temperatures in downstream areas which may be used for steelhead rearing.

Intrusion into the riparian area may result in elevated water temperatures which may be transferred downstream to rearing habitat in lower Clover Valley Creek and Antelope Creek. Many studies have shown that removal of canopy leads to an increase in incident solar radiation which elevates water temperature (Beschta & Taylor 1988; Brown & Krygier 1970; Holtby 1988), even in downstream reaches (Spence *et al.* 1996). An increase in water temperature can cause sublethal effects on salmonids, such as a decrease in spawning success, and reduced growth during the juvenile rearing stage (Spence *et al.* 1996). Unusual stream temperatures during upstream migration periods can alter or delay migration timing, accelerate or retard migrations, and increase fish susceptibility to disease. Elevated temperatures, especially for extended periods of time, can also prove lethal to all life stages of steelhead. Adult steelhead generally require water temperatures less than 57°F to spawn successfully. Warming of stream temperatures through loss of riparian canopy can advance development or alter the timing of life-history events and potentially disrupt natural synchronies in biological cycles that have evolved over thousands of years. Thus, small changes in temperature may prove ecologically damaging even when such changes produce no evidence of acute or chronic physiological stress (Spence *et al.* 1996).

Stormwater and Sediment

Increases in quantity of storm water and residential yard runoff would, over time, lead to a gradual decrease in water quality. Storm water routed off road and driveway surfaces during rainfall events contains hydrocarbons, heavy metals, sediment, fertilizers, and other pollutants. The project proposes to use Vortechnics™ storm water filters to filter storm flows up to a two-year event. The filters remove fine sand and coarse particles of approximately 60 mm and larger which indicates silt (less than 60 mm) would be able to pass through the filters. Silt entering the creek would flow downstream and may settle in Antelope Creek or Secret Ravine which are the main spawning and rearing areas for steelhead in the Dry Creek watershed. Sediment inputs to downstream waters could impact spawning gravels by filling interstitial spaces reducing gravel permeability and potentially smothering eggs and decreasing the amount of already limited available spawning habitat. These downstream areas are currently impacted by excessive sedimentation and any additional input could have deleterious effects on habitat quality and could decrease the already limited amount of gravel spawning areas available, effectively reducing the amount of possible salmonid production. Input of fine sediments would likely be most noticeable during the initial construction phase and should decrease over time. However, homeowners who are located in parcels directly abutting the creek could impact water quality with input of sediment or fertilizers from backyard activities. The stormwater filters would be removing a substantial portion of the sediment and because the majority of the known spawning areas are in tributaries upstream of the action area, it is expected that the impacts to downstream areas would not be significant enough to affect population levels of steelhead in the Dry Creek watershed, primarily because the most current surveys identified most spawning areas upstream of the action area. It is not known if spawning areas are primarily currently located in only a few upstream areas because of the existing excess sediment in the watershed, or if these areas are preferred because of . Several restoration projects have recently occurred or are planned in the Dry Creek watershed to improve riparian cover, rearing and spawning habitat, and enhance spawning gravel availability. An increase in sediment downstream, emanating from the Clover Valley Lakes project, may adversely affect the effectiveness of the downstream restoration projects.

Stormwater and Water Quality

In study to determine if a relationship exists between stream quality and the extent of watershed urbanization, Klein (1979) found that stream quality impairment is first evidenced when watershed imperviousness reaches 12 percent, but does not become severe until imperviousness reaches 30 percent. Schueler and Holland (2000) found that stream degradation occurs at relatively low levels of imperviousness (~10 percent). The Clover Valley Lakes project will contribute approximately 432 acres of development (622 acres total - 190 acres of open space) which equals 22 percent of the watershed (1,940 acres). Not all of the development will become impervious, however, there are existing developments in the Clover Valley Creek watershed which combined would likely total greater than 30 percent imperviousness. Klein (1979) also detected a positive correlation between degree of water quality impairment and percent imperviousness within a watershed. A (1993) study conducted by NOAA Fisheries scientists found juvenile chinook salmon exposed to water quality contaminants in urban estuaries had suppressed immune responses, reduced survival, and possible decreased growth (Varanasi *et al.* 1993). The primary chemical contaminants found in these juvenile chinook were aromatic hydrocarbons and PCBs which are common constituents found in urban stormwater runoff. The close proximity of the proposed road network, including five stream crossings, to Clover Valley Creek would indicate some direct runoff from the road network into the creek would occur during storm events. The Dry Creek watershed flows to the NEMDC which is on the 303(d) list as polluted with PCBs with the probable source as urban runoff/strom sewer. Outmigrating smolts from lower Clover Valley and Antelope creeks would be susceptible to suppressed immune responses, decreased growth, and reduced survival which may be exacerbated by an increase in water pollutants from the proposed development.

Construction of the road and stream crossings may adversely impact water quality. The proximity of the road to the creek would likely result in some impairment of water quality arising from hydrocarbon and other road-derived pollutants entering the water course during precipitation events. Skinner *et al.* (1999) found fish embryos and larvae to be particularly vulnerable to the adverse effects of pollution contained in storm water runoff with impacts ranging from developmental abnormalities to lethal effects of two fish species, medaka (*Oryzias latipes*) and inland silverside (*Menidia beryllina*), using storm water runoff from several creeks in San Diego County. Of particular interest is the fact that one of the creeks used in the study has a watershed comprised of 60 percent designated open space. They found effluent concentrations as low as 5-10 percent produced statistically elevated abnormal fish embryo or larval development in the majority of the storm water samples tested (Skinner *et al.* 1999). Decreased viability of developing larvae can eventually lead to a reduction in population size.

The use of filter systems would decrease the likelihood of this event occurring often, however, during storm events in excess of a two-year storm, filters would be overloaded and unable to remove pollutants. The immediate toxic effect of the pollutants would be minimized by dilution, however, the pollutants would ultimately be delivered downstream. During large storms direct road runoff would likely run right into the creek where the road abuts directly against the creek corridor (see Fig.1) because the filter units would be overloaded. Because the road abuts right up to the creek (at one measured location the setback was 0') there would not be another means to filter out pollutants such as through routing flows down a grassy swale or through an off-channel wetland during high flow periods when the filters are unable to keep up with flows or if filters should become clogged. The proposed project also includes filling in 2.56 acres of wetlands which would decrease the capacity of the site to filter out pollutants and sediment before they would enter the stream. There is also some question as to the efficacy of storm water filters in removing sediments which may have pollutants, such as heavy metals, bound to them, and in removing the unbound toxins (Brown and Schueler 2001). Urban storm water is also often toxic to several species of aquatic insects, the prey base for salmonids (Jones and Clark 1987). This may result in reduced growth of juvenile salmonids which would likely lead to decreased survival rates.

Stormwater and Water Quantity

Increased storm water runoff, as occurs when infiltration is reduced by development and an increase in impervious surfaces, causes an increase in the frequency and severity of flooding as well as a reduced base flow. Klein (1979) detected a definite relationship between baseflow and watershed imperviousness, generally, as watershed imperviousness increased, baseflow diminished.

Development within Clover Valley will result in decreased infiltration as open space is replaced by roads, driveways, and houses, which will cause increased storm water runoff. Leopold (1968) stated that a direct relationship exists between the number of bankfull flows that occur and the extent of watershed urbanization (*in* Klein 1979). When watershed imperviousness reaches 40 percent, bankfull flows occur three times annually (Klein 1979). In unimpaired watersheds bankfull condition has an average recurrence interval of once every 1.5 years (Leopold *et al.* 1964). Channel response to more severe and frequent flood events typically results in an increase in the channel's cross-sectional area accomplished through either widening the stream banks or downcutting the stream bed, or frequently, both (Schueler and Holland 2000). Because the design of this project intends to utilize a hard surface, specifically a stream crossing with two culverts, as a means to slow the stormwater flow, channel response may be widening above the culverts as velocities are forcibly reduced and stream bed downcutting below the culverts as velocity increases through the culvert. The channel responses would likely result in a degradation of salmonid habitat, such as loss of pool riffle sequences and decrease in overhead cover, in the project area and in downstream areas. In time, these crossings could also cause another passage barrier due to the culvert "perching" when the streambed immediately downstream scours out. Currently the project area may not contain anadromous salmonids due to a downstream golf course road crossing that constitutes a barrier to upstream migration; however, passage past this existing barrier is restorable. The culvert at this crossing on Argonaut Avenue, is severely rusted out and will likely need replacing soon.

Stormwater and Channel Erosion

The design of the road crossing includes a box culvert, which is intended to pond water behind it as a means of downstream flood control. This is likely to result in downstream scour over time. Scour of the channel and banks would result in sediment deposition downstream and may also lead to a loss of pool habitat as it becomes filled in, a decrease in spawning habitat, and a decrease in macroinvertebrate prey base. Erosion and bank scour may also lead to continued and gradual destruction of riparian habitat as riparian trees and shrubs have their root system undermined eventually falling in and causing increased sediment input. This scenario is visibly apparent in the downstream sections of Dry Creek where it passes through the Roseville city limits. However, there is little that can be done to ameliorate the problem within the city because development was allowed to encroach on the creek and because continued upstream development contributes higher storm flows than occurred prior to development when open space allowed for infiltration. For example, the area along Dry Creek in Saugstad Park within Roseville has been experiencing such substantial bank scour that oak trees are falling instream and an emergency bank stabilization project was warranted due to bank scour eating into a former landfill and exposing potentially dangerous waste into the creek environment.

Erosion of the banks introduces a large quantity of sediment to the creek and this could result in stream channel widening. Klein (1979) detected a widening of stream channels in urban streams approximately twice the width of comparable rural streams. This phenomenon is also currently occurring in the downstream reaches of Dry Creek where the bottom substrate is composed of nearly 100 percent sand and provides poor rearing habitat, and little refugia for migrating salmonids.

The dual culvert crossing is designed to pond water and slow the downstream flow to alleviate downstream high flows and flood events during storms. However, the five road crossings and road placement along the creek channel will result in replacing natural wetland pond overflow areas with a hard structure solution which will constrict the natural flow. Once the flow is constricted as it will be at the culverts, water velocity increases and this energy increase is transferred downstream (Leopold *et al.* 1964) leading to accelerated scour at culvert outlets (Furniss *et al.* 1991). Channel scour would cause increased sediment to enter the water course which would be conveyed downstream and may consequently impact steelhead. Juvenile steelhead may have decreased feeding opportunities due to excess turbidity impairing the ability to capture prey. The prey base of aquatic invertebrates may become reduced in abundance and diversity as a result of increased sediment which would, in turn, decrease feeding opportunity for salmonids. Sediment deposition downstream would also contribute to a decrease in habitat complexity reducing the amount of available habitat for salmonids, and may also result in increased predation on juvenile steelhead by predatory fishes as areas of refugia are reduced or eliminated.

Overall Impacts

The project proponents have proposed several design features that would lessen the severity of impacts project construction and continued existence would have on aquatic habitat and Central Valley steelhead. Inclusion of driveway filter strips constructed of permeable pavement located at the bottom of all driveways would allow more storm water to infiltrate than would regular pavement, effectively reducing the percent imperviousness of the entire project by a small percentage. However, the percent imperviousness within the relatively small Clover Valley watershed would still exceed amounts considered by some to cause aquatic habitat degradation (Schueler and Holland 2000, Klein 1979). Impacts to salmonid habitat from increased storm flows may occur downstream in the Dry Creek watershed where steelhead are known to exist and where current habitat conditions already include excessive sedimentation and channel erosion, often resulting in decreased overhead canopy cover and increased water temperatures as mature riparian trees are undercut and removed or fall (DCC 2001; F. K. Finn, NOAA Fisheries, pers.obs.; Titus, CDFG, 2001). The impact of habitat degradation in downstream areas would adversely affect the amount and quality of juvenile rearing habitat which may further reduce the amount of salmonids the watershed can support. As we do not have a good estimate of the number of steelhead currently using this watershed, it is difficult to assess if a concomitant reduction in the population would ensue. Impacts on current spawning areas would be less than significant because the majority of suitable spawning gravel is located in areas upstream from the confluence with Clover Valley and Antelope creeks.

The project design includes roads that parallel the creek and cross it five times. Storm water from the paved surfaces is proposed to be channeled off the road and through Vortechnics™ storm water filters sized to accommodate a two-year storm event. Use of these filters is designed to remove fine sand and coarse particles greater than 60 millimeters. They are also designed to remove floating pollutants and settleable solids from surface runoff. However, the Vortechnics™ storm filter systems would only remove a portion of the pollutants found in road runoff with the actual removal efficiency decreasing with increased amount of flow. Studies have shown storm water filter systems, especially oil-grit separators, to often operate ineffectively at pollutant removal (Schueler and Holland 2000). Over time, water quality would likely become degraded as storm water entered the stream without sufficient pollutant removal and as development continues within the watershed.

Construction of two of the stream crossings using the double-culvert design is intended to pond water and alleviate potential downstream flooding resulting from stormwater runoff from the Clover Valley Lakes development. This proposed design would likely result in increased velocity through the [lowest] culverts which would likely cause scour in the channel below the culvert outlet and at the bridge itself which could undermine the bridge (D. Odenweller, NOAA Fisheries Engineering; pers.comm.). Downstream scour would cause sediment to be transmitted downstream where it would settle out in a depositional area. Sediment deposited downstream may decrease the quality of juvenile steelhead rearing habitat.

It is difficult to predict the exact nature of long-term impacts this project may have on the Central Valley steelhead within the Dry Creek drainage and ESU-wide due to the limited amount of data on the use of small creeks by steelhead in the Central Valley. Project implementation may, however, over time, result in Clover Valley Creek becoming increasingly modified which would result in poor habitat for salmonids. Improved passage is likely to occur in the next few years as the culvert at Argonaut Road is replaced, however, habitat degradation through sedimentation and other water quality impacts, such as nutrient and road runoff pollutant loading, resulting from upstream development, including the Clover Valley Lakes project, may limit the number of rearing steelhead able to use habitat and feed in Clover Valley Creek. Arkoosh *et al.* (1991) found that juvenile chinook salmon that migrate through an urban estuary contaminated with PCBs and PAHs bioaccumulated these pollutants and exhibited suppressed immune response compared to fish from an uncontaminated rural estuary (*in* Spence *et al.* 1996). This same response may occur in steelhead rearing in small urbanized watersheds in the Central Valley, including Clover Valley Creek and the Dry Creek watershed resulting in a gradual decrease in distribution as habitat conditions worsen.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Non-Federal actions that may occur in the action area include additional development as build-out continues throughout western Placer County. Accompanying the increase in commercial and residential development is the expansion and new construction of associated infrastructure including transportation, water, and energy, and sewer systems. This will further increase the amount of impervious surfaces, reduce the amount of open space, and may lead to a gradual further degradation of watershed processes and habitat values.

VII. CONCLUSION

Based on the best available scientific and commercial information, a review of the current status of Central Valley steelhead, the environmental baseline for the action area, the effects of the proposed project and the cumulative effects, it is NOAA Fisheries' biological opinion that the Corps' issuance of a Nationwide permit for the Clover Valley Lakes project, as proposed, is not likely to jeopardize the continued existence of the threatened Central Valley steelhead ESU.

VII. INCIDENTAL TAKE STATEMENT

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. NOAA Fisheries further defines "harm" as an act that actually kills or injures a protected species (64 FR 60727). Harm can arise from significant habitat modification or degradation where it actually kills or injures protected species by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and section 7(o)(2), take that is incidental to and not intended as part of the agency action is not considered to be prohibited take under the ESA provided that such take is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are nondiscretionary, and must be undertaken by the Corps so that they become binding conditions of any permit issued to Clover Valley Lakes, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered under this incidental take statement. If the Corps: (1) fails to assume and implement the terms and conditions, or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps or the applicant must report the progress of the action and its impact on the species to NOAA Fisheries as specified in the incidental take statement [50 CFR §402.14(i)(3)].

A. Amount or Extent of Take

Construction of the proposed Clover Valley Lakes development project within the Clover Valley Creek watershed may result in some incidental take of Central Valley steelhead, however, use of work windows and best management practices should greatly minimize potential take. After the project is built, however, chronic and long-term gradual degradation of the aquatic habitat and water quality may over time result in incidental take of steelhead in waters downstream from the project site. There are no population estimates for steelhead using the Dry Creek watershed. Due to the paucity of information on steelhead use of the entire watershed, NOAA Fisheries is unable to estimate the specific number of fish which could be taken throughout the life of the development.

NOAA- Fisheries anticipates numbers of steelhead taken by either short- or long-term impacts to habitat will be difficult to quantify because dead or impaired individuals downstream would be difficult to detect. Take would occur if the cumulative effects of sediment and pollutants from the project site are transported downstream and result in impaired habitat conditions. Steelhead may react by avoidance, decreased feeding, or other behavioral effects which would also be difficult to detect. Proper use of best management practices, and the terms and conditions of this biological opinion should minimize take of listed fish. However, the following level of take of

Central Valley steelhead can be anticipated by loss of habitat quality through water quality impairment, increased sedimentation, and altered downstream flows which will result from stormwater runoff emanating from the proposed road network flowing into the creek, flood control at the two stream crossings and reduction in wetlands at the project site.

B. Effect of Take

In the accompanying biological opinion, NOAA Fisheries determined that this level of anticipated take is not likely to result in jeopardy to Central Valley steelhead.

C. Reasonable and Prudent Measures

NOAA Fisheries believes the following reasonable and prudent measures are necessary and appropriate to minimize the incidental take of Central Valley steelhead caused by the Clover Valley Lakes project.

1. The Corps shall ensure that impacts resulting from project construction are minimized; and

2. The Corps shall ensure that impacts resulting from habitat loss or reduction in quality are minimized.

D. Terms and Conditions

The Corps is responsible for compliance with the following non-discretionary terms and conditions that implement the reasonable and prudent measures described above. These terms and conditions are intended to minimize incidental take of Central Valley steelhead.

1. The Corps shall ensure that impacts resulting from project construction are minimized.

   a. All in-channel work shall occur only between June 1 - October 15;

   b. Best management practices shall be employed during all phases of construction to minimize soil erosion, removal of wetland and riparian vegetation, siltation, and introduction of pollutants to the creek.

   c. When practical, during construction of the stream crossings, workers shall perform work from the top of the creek banks for the purposes of avoiding work and heavy equipment in flowing water, disturbing creekbank vegetation, and instream habitat. All riparian vegetation that is removed or destroyed shall be replaced on-site at a 3:1 ratio.

   d. If coffer dams are used, water pumped out of the dam which may be turbid or that contacts wet concrete shall be pumped out and disposed of outside the creek channel in a location, such as a detention pond, where it will not re-enter the flow of the creek.

e. Culverts not intended to be used as flood control devices shall be designed so they do not impede fish migration or alter channel characteristics, such as by using bottomless arches and being sized to accommodate the active channel width, as described in NOAA Fisheries Fish Passage Guidelines (Attachment 1).

2. The Corps shall ensure that impacts resulting from habitat loss or reduction in quality are minimized.

a. The Corps shall ensure the Vortechnics™ filtration system is maintained in perpetuity to ensure they are functioning properly to remove pollutants and protect water quality. A copy of the maintenance contract shall be submitted to NOAA Fisheries within 90 days following completion of installation.

b. The applicant shall send a report at project construction completion with a written description of instream construction activities and implementation of proposed minimization measures. The report shall include photographs of the five stream crossings before, during, and immediately after the project is completed for the purpose of developing a reference library of instream and riparian habitat characteristics.

c. Water quality shall be monitored before construction as a baseline and during the first rainy season after project completion to ensure the filtration systems are functioning properly. Samples should be taken from below at least five stormwater outlets and should capture the 'first flush' storm. NOAA Fisheries must review and approve of the final design of the monitoring plan prior to implementation. A monitoring report shall be submitted to NOAA Fisheries within 90 days following completion of sampling. All reports shall be submitted to:

Supervisor, Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento, CA 95814-4706

d. The bike trail shall be designed such that it does not enter the riparian corridor or existing wetlands and design should include maintaining a setback from riparian vegetation of 50' to avoid further encroachment on the creek corridor. Bike trail layout and construction activities should avoid disturbance and removal of riparian vegetation to the maximum extent possible.

VIII. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

NOAA Fisheries believes the following conservation recommendations are consistent with these obligations, and therefore should be implemented by the Corps.

2. The Corps shall encourage the applicant to consider redesigning the layout of the road system within the development whereby the road would not be closer to the creek than a minimum of 75' from the edge of the riparian zone to protect the aquatic habitat. The Corps shall also encourage the applicant to consider redesigning the two crossings with the double culvert design intended to slow storm flows and serve as flood control such that they are not at risk of causing excessive velocities, downstream erosion, and scour.

3. The Corps shall encourage implementation of measures to provide upstream fish passage through Clover Valley Creek by replacing downstream barriers to migration such as the culvert at Argonaut Road.

IX. REINITIATION NOTICE

This concludes formal consultation on the effects of the proposed Clover Valley Lakes development project on Central Valley steelhead. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or authorized by law) and if: (1) the amount or incidental take specified in the incidental take statement is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species not considered in this opinion, or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be initiated immediately.

XI. LITERATURE CITED

Barnhart, R.A. 1986. Species Profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest), steelhead. U.S. Fish Wild. Serv. Biol. Rep. 82(11.60), 21 p.

Bell, M.C. 1986. Fisheries Handbook of Engineering Requirements and Biological Criteria (second edition). U.S. Army Corps of Engineers, Portland, OR.

Beschta, R. L. 1991. Stream habitat management for fish in the northwestern United States: the role of riparian vegetation. Am. Fish. Soc. Symp. 10:53-58.

Beschta, R.L. and R.L. Taylor. 1988. Stream temperature increases and land use in a forested Oregon watershed. Water Resources Bulletin 24(1):19-25.

Bjornn, T.C. and D.W. Reiser.1991. Habitat requirements of salmonids in streams. Pg. 83-138 *in* W.R. Meehan, Editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Pub. 19.

Bovee, K. D. 1978. Probability of use criteria for the Family Salmonidae (Instream Flow Information Paper No. 4, FWS/OBS-78-07). Washington D.C., U. S. Fish and Wildlife Service, Division of Biological Services, Western Energy and Land Use Team.

Brown, G.W. and J.T. Krygier. 1970. Effects of clear-cutting on stream temperature. Water Resources Research 6(4): 1133-1139.

Brown and T. R. Schueler. 2001. Stormwater treatment practice (STP) pollutant removal performance database, 2nd edition. Access their website at www.cwp.org.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dept. Comm., NOAA Tech. Memo. NOAA Fisheries-NWFSC-27. 261pp.

CALFED Bay-Delta Program. 1999. Ecosystem Restoration Program Plan, Vol. II. Tech. Appendix to draft PEIS/EIR. June 1999.

CDFG. 1972. April 10, 1972 memorandum to files regarding information on stream fisheries for the Roseville Master Plan.

CDFG. 1975. September 29, 1975 memorandum to Linda Creek files regarding an electrofishing survey.

CDFG. 1985. Final Draft, Riparian Resources of the Central Valley and California Desert. Prepared by R.E. Warner and K.M. Hendrix. 235pp. + appendices.

CDFG. 1989. August 23, 1989 letter to Mr. Loren Clark, Placer County Community Development Department from Mr. Fred Meyer, Associate Fishery Biologist regarding the history of salmon in Dry Creek.

Clark, G.H. 1929. Sacramento-San Joaquin salmon (*Oncorhynchus tshawytscha*) fishery of California. Calif. Fish Game Bull. 17:73

Coble, D.W. 1961. Influence of water exchange and dissolved oxygen in redds on survival of steelhead trout embryos. Trans. Am. Fish. Soc. 90(4):469-474.

Cummins, K.D., D. Botkin, H. Regier, M. Sobel, and L. Talbot. 1994. Status and future of salmon of western Oregon and northern California: management of the riparian zone for the conservation and production of salmon. Draft Research Report. The Center for the Study of the Environment, Santa Barbara, California.

Dry Creek Conservancy (DCC). 2001. Secret Ravine Adaptive Management Plan, A Placer County tributary of the Dry Creek Watershed.

Everest, F.H. 1973. Ecology and management of summer steelhead in the Rogue River. Oregon State Game Commission. Fishery Research Report 7. 48p.

Furniss, M.J., T.D. Roelofs, and C.S. Yee. 1991. Road construction and maintenance. Pgs. 297-324 *in* W.R. Meehan, Ed. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19. Bethesda, MD.

Gregory, S.V., F.J. Swanson, W.A. McKee, and K.W. Cummins. 1991. An ecosystem perspective of riparian zones: focus on links between land and water. Bioscience 41: 540-551.

Hallock, R.J., W.F. Van Woert and L. Shapavalov. 1961. An evaluation of stocking hatchery-reared steelhead rainbow trout (*Salmo gairdneri gairdneri*) in the Sacramento River system. Calif. Fish Game Fish Bull. 114, 73 p.

Holtby, L.B. 1988. Effects of logging on stream temperatures in Carnation Creek, British Columbia, and associated impacts on the coho salmon (*Oncorhynchus kisutch*). Can. Jour. Fish. Aq. Sci. 45:502-515.

Jones, R.C. and C.C. Clark. 1987. Impact of watershed urbanization on stream insect communities. Water Resources Bulletin, vol. 23(6):1047-1055.

Interagency Ecological Program (IEP) Steelhead Project Work Team. 1999. Monitoring, Assessment, and Research on Central Valley Steelhead: Status of Knowledge, Review Existing Programs, and Assessment Needs. In Comprehensive Monitoring, Assessment, and Research Program Plan, Tech. App. VII-11.

Klein, R.D. 1979. Urbanization and stream quality impairment. Water Resources Bulletin, Volume 15(4): 948-963.

Leidy, G. R., and S. Li. 1987. Analysis of river flows necessary to provide water temperature requirements of anadromous fishery resources of the lower American River. Lower American River Curt reference, EDF V. EBMUD, Exhibit No. 69-A. Prepared by McDonough, Holland, and Allen, Sacramento, CA.

Leopold, L.B., M.G. Gordon, and J.P. Miller. 1964. Fluvial Processes in Geomorphology. Dover Publications Inc. 522 pp.

McEwan, D. and T.A. Jackson. 1996. Steelhead Restoration and Management Plan for California. California Dep. Fish Game, 234 p.

Nelson, John. Personal communication. Environmental Specialist, California Department of Fish and Game, Rancho Cordova, CA., December 2001.

Phillips, R.W. and H.J. Campbell. 1961. The embryonic survival of coho salmon and steelhead trout as influenced by some environmental conditions in gravel beds. Annual Rep. Pac. Mar. Fish. Comm. 14:60-73.

Reiser, D.W. T.C. Bjornn. 1979. Habitat requirements of anadromous salmonids. *In* Influence of Forest and Rangeland Management on Anadromous Fish Habitat in the Western United States and Canada. W.R. Meehan, editor. U.S. Department of Agriculture Forest Service General Technical Report PNW-96.

Reynolds, F.L., T.J. Mills, R. Benthin, and A. Low. 1993. Restoring Central Valley streams: a plan for action. California Department of Fish and Game, Inland Fisheries Division, Sacramento.

Schlosser, I. J. 1991. Stream fish ecology: a landscape perspective. Bioscience Vol. 41, No. 10, pp 704-712.

Schueler, T.R., and H.K. Holland, eds. 2000. The Practice of Watershed Protection. Pub. By The Center for Watershed Protection, Ellicott City, MD.

Shapovalov, L. and A.C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri)* and silver salmon (*Oncorhynchus kisutch*) with special reference to Waddell Creek, California, and recommendations regarding their management. Calif. Dep. Fish Game, Fish Bull. 98, 375 p.

Smith, A.K. 1973. Development and application of spawning velocity and depth criteria for Oregon salmonids. Trans. Amer. Fish. Soc. 10(2):312-316.

Skinner, L., A. dePeyster, and K. Schiff. 1999. Developmental effects of urban storm water in medaka (*Oryzias latipes*) and inland silverside (*Menidia beryllina*). Arch. of Environ. Contam. Toxic. 37: 227-23.

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, OR.

Sullivan, K., T. E. Lisle, C. A. Dolloff, G. E. Grant, and L. M. Reid. 1987. Stream channels: the link between forests and fishes. In Streamside Management: Forestry and Fishery Interactions; E. O. Salo and T. W. Cundy, eds. Pgs. 191-232. Contribution 57, University of Washington, Institute of Forest Resources. Seattle, Washington.

Titus, Rob. 2001. CDFG Memorandum. Dated November 5, 2001. Perennial rearing habitat for juvenile steelhead in the Dry Creek drainage (Placer County).

Thompson, K. 1972. Determining stream flows for fish life. In Proceedings, Instream Flow Requirement Workshop. Pacific Northwest River Basin Commission, Vancouver, WA. Pp. 31-50.

United States Fish and Wildlife Service. 1993. Revised Draft of the Fish and Wildlife Coordination Act, Section 2(B) Report for the Sacramento River Bank Protection Project, Contract 42A. Prepared for the U.S. Army Corps of Engineers, Sacramento by the U.S. Fish and Wildlife Service, Ecological Services, Sacramento, California. 62 p. with appendices.

Varanasi, U., E. Casillas, M.R. Arkoosh, T. Horn, D.A. Misitano, D.W. Brown, S. Chan, T.K. Collier, B.B. McCain, and J.E. Stein. 1993. Contaminant exposure and associated biological effects in juvenile Chinook salmon (*Oncorhynchus tshawytscha*) from urban and nonurban estuaries of Puget Sound. NOAA Technical Memorandum NMFS-NWFSC-8.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher and P. B. Moyle. 1996. Historical and present distribution of chinook salmon in the Central Valley drainage of California. Pp. 309-362. IN: Sierra Nevada Ecosystem Project: Final report to congress, vol. III, Assessments, Commissioned Reports, and Background Information. Davis: University of California, Centers for Water and Wildland Resources.

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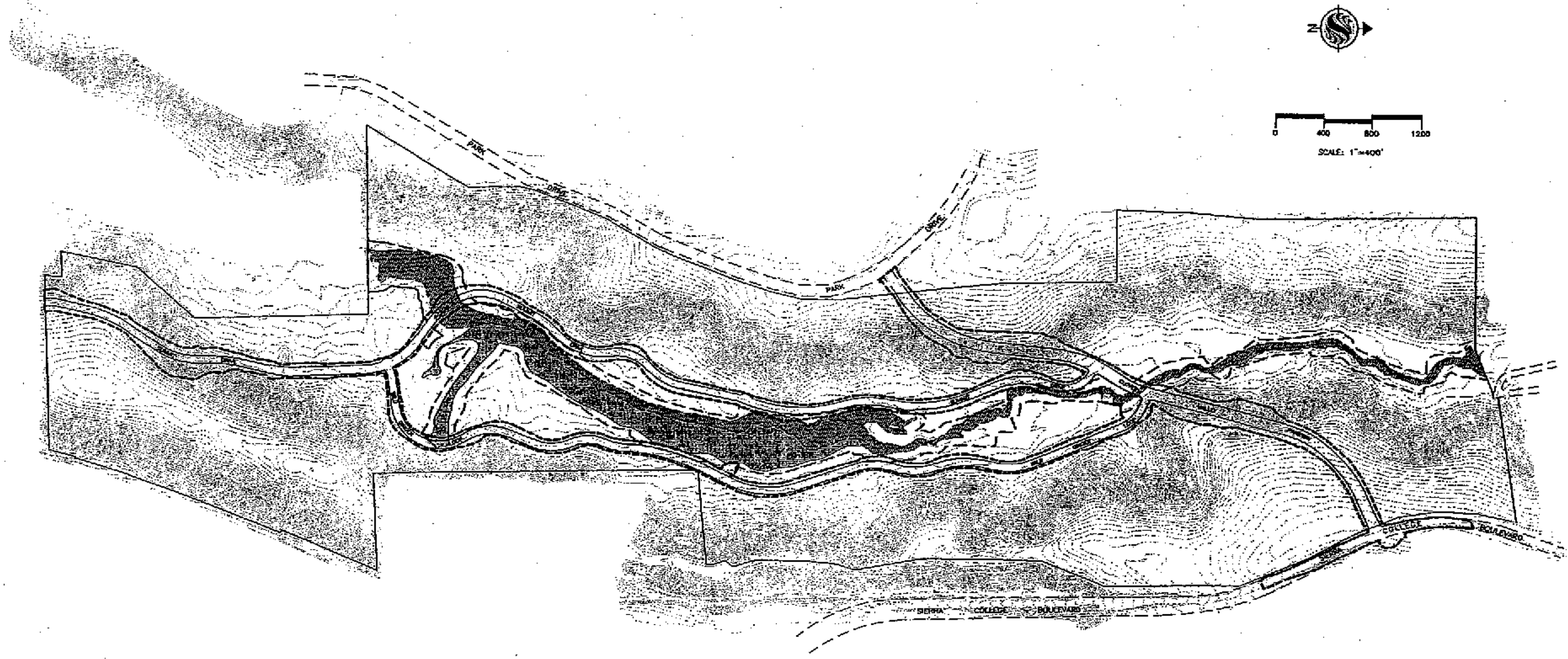
ENVIRONMENTAL SENSITIVITIES

CLOVER VALLEY LAKES

Figure 1

CITY OF ROCKLIN CALIFORNIA



DEVELOPED AREA	382.48 ACRES
Includes: Major Road Areas; Manufactured Slope Areas; Tree Removal Areas	
UNDEVELOPED AREA	239.78 ACRES
Includes: Open Space Areas (Outside of Lot Area); Riparian Area Including: Seasonal Area, 70' Average Wetland Buffer, 100-Year Flood Plain, Parks, Archaeological Areas	
Total	622.26 ACRES

LEGEND

- Riparian Area
- Seasonal Area
- 70' Average Wetland Buffer Line
- Proposed Cut/Fill Slope

Stantec Consulting Inc.
2590 Venture Oaks Way
Sacramento, CA
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Fax. 916.921.9274
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Stantec

Figure 1

RP&M

Enclosure 2

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) set forth new mandates for the National Marine Fisheries Service (NOAA Fisheries), regional fishery management councils, and federal action agencies to identify and protect important marine and anadromous fish habitat. The Councils, with assistance from NOAA Fisheries, are required to delineate "essential fish habitat" (EFH) in fishery management plans (FMPs) or FMP amendments for all managed species. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with NOAA Fisheries regarding potential adverse effects of their actions on EFH.

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

Essential fish habitat is defined in the MSFCMA as: "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity..." NOAA Fisheries regulations further define "waters" to include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" to include sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" to mean the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" to cover a species' full life cycle.

The geographic extent of freshwater essential fish habitat (EFH) for the Pacific coast salmon fishery includes waters currently or historically accessible to salmon within specific U.S. Geological Survey (USGS) hydrologic units (PFMC 1999). For the action area within the Clover Valley Creek watershed the aquatic areas that may be identified as EFH for Pacific salmon are within the USGS hydrologic unit map numbered 18020111.

Clover Valley Creek flows into Antelope Creek which flows into Secret Ravine which becomes Dry Creek at its downstream end. California Department of Fish and Game (CDFG) letters and reports dating back to 1965 indicate the presence of chinook salmon runs within the Dry Creek drainage (CDFG 1965, 1972, 1989). Primary spawning streams for salmon within the drainage are Secret Ravine and Miner's Ravine, which flow into Dry Creek. A 1989 letter from CDFG biologist Fred Meyer to Mr. Loren Clark of the Placer County Development Department estimates that recent populations of chinook salmon within the Dry Creek drainage range from 100 to 1,000 fish. The letter also states that CDFG plants salmon fry from the Feather River hatchery into the stream when adult counts have been low. The monitored growth of these fry was excellent, which may indicate that habitat conditions within the drainage were satisfactory for juvenile rearing.

The Dry Creek Conservancy (DCC) currently conducts annual spawning surveys centered around the fall-run chinook spawning period. In 2000, the DCC observational sampling recorded 210 adult chinook and 134 carcasses. The City of Roseville has been monitoring Linda and Cirby Creeks, tributaries to Dry Creek for several years. During the 2001 season 40 adult chinook were observed in Cirby and Linda creeks which have the most impact from urban development and encroachment of all Dry Creek tributaries.

General life history information for chinook salmon is summarized below. Further detailed information on chinook salmon ESUs are available in the NOAA Fisheries status review of chinook salmon from Washington, Idaho, Oregon, and California (Myers et al. 1998), and the NOAA Fisheries proposed rule for listing several ESUs of chinook salmon (NMFS 1998).

Central Valley fall-run chinook enter the Sacramento and San Joaquin Rivers from July through April and spawn from October through December (FWS 1998) with spawning occurring from October through December. Peak spawning occurs in October and November (Yoshiyama et al. 1998). Chinook salmon spawning generally occurs in swift, relatively shallow riffles or along the edges of fast runs at depths greater than 6 inches, usually 1-3 feet to 10-15 feet. Preferred spawning substrate is clean loose gravel and gravels are unsuitable when they have been cemented with clay or fines or when sediments settle out onto redds reducing intergravel percolation (NMFS 1997).

Egg incubation occurs from October through March, and juvenile rearing and smolt emigration occurs from January through June (Reynolds et. al. 1993). At the time of emergence from their gravel nests, most fry disperse downstream towards the estuary shortly after they emerge or as smolts (Kjelson et al. 1982), hiding in the gravel or stationing in calm, shallow waters with fine sediments substrate and bank cover such as tree roots, logs, and submerged or overhead vegetation. Juvenile rearing occurs from January through mid May and the smaller fry inhabit marginal areas of the river, particularly back eddies, behind fallen trees, undercut tree roots or over areas of bank cover (Lister and Genoe 1970). Juvenile emigration occurs from mid March through mid June. Chinook salmon fry prefer slower velocity streambank areas and orient upstream to the current as opposed to the smolt stage that swims downstream with the current (Schaffter 1980). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, submerged and overhead cover in the form of rocks, submerged aquatic vegetation, logs, riparian vegetation, and undercut banks provide food, shade and protect juveniles from predation.

Principal foods of chinook salmon while rearing in freshwater and estuarine environments are larval and adult insects and zooplankton such as Daphnia, flies, gnats, mosquitoes or copepods (Kjelson et al. 1982), stonefly nymphs or beetle larvae (Chapman and Quistdorff 1938) as well as other estuarine and freshwater invertebrates.

II. DESCRIPTION OF PROPOSED ACTION

The proposed action is described in Part II of the preceding biological opinion.

III. EFFECTS OF THE ACTION

Potential impacts of the project to Pacific coast salmon EFH would be similar to the effects of the action discussed in the preceding biological opinion concerning impacts to threatened Central Valley steelhead. These impacts include (1) degradation of riparian vegetation and its associated functions including maintenance of cool water temperatures, input of nutrients and woody debris, provision of habitat heterogeneity and refugia areas; (2) degradation of water quality from increased suspended sediment, pollutants, and excess nutrient runoff from home lawns and fertilizers; and (3) a decrease in water filtering capacity due to destruction of wetlands during construction. Most impacts which may occur in Clover Valley Creek in the project area from construction activities and continued existence of the development would be transferred via stream flow downstream to Dry Creek waters known to contain Central Valley fall-run Chinook salmon.

IV. CONCLUSION

Upon review of the effects of the Clover Valley Lakes development project, NOAA Fisheries believes that the proposed project may adversely affect EFH of fall-run chinook in the Dry Creek watershed due to channel disturbance from construction and its associated downstream sedimentation. Long-term degradation of water quality and aquatic habitat features caused by conversion of open space to impervious surfaces, increased storm water flows, increased pollutants in storm water runoff, destruction of wetlands, and encroachment of development and roads into the riparian and aquatic habitat of Clover Valley Creek. Although salmon are currently not likely to be in the majority of Clover Valley Creek due to a culvert barrier near the confluence with Antelope Creek, this is a temporary barrier which could be easily remedied and passage restored.

V. EFH CONSERVATION RECOMMENDATIONS

NOAA Fisheries recommends that Reasonable and Prudent Measures Nos. 1 and 2 and their respective Terms and Conditions listed in the Incidental Take Statement prepared for Central Valley Steelhead in the preceding Biological Opinion be adopted as EFH Conservation Recommendations. In addition, NOAA Fisheries recommends that the two ESA Conservation Recommendations be adopted as EFH Conservation Recommendations. These recommendations are provided as advisory measures:

1. The Corps shall encourage the applicant to consider redesigning the layout of the road system within the development whereby the road would not be closer to the creek than a minimum of 75' from the edge of the riparian zone to protect the aquatic habitat. The Corps shall also encourage the applicant to consider redesigning the two crossings with the double culvert design intended to slow storm flows and serve as flood control such

that they are not at risk of causing excessive velocities, downstream erosion, and scour.

2. The Corps shall encourage implementation of measures to provide upstream fish passage through Clover Valley Creek by replacing downstream barriers to migration such as the culvert at Argonaut Road.

VI. CORPS OF ENGINEERS' STATUTORY REQUIREMENTS

The MSFCMA and Federal regulations (50 CFR Sections 600.920) to implement the EFH provisions of the MSFCMA require federal action agencies to provide a written response to EFH Conservation Recommendations within 30 days of their receipt. A preliminary response is acceptable if final action cannot be completed within 30 days. Your final response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity. If your response is inconsistent with our EFH Conservation Recommendations, you must provide an explanation of the reasons for not implementing them.

VII. REFERENCES

Chapman, W.M. and E. Quistdorff. 1938. The food of certain fishes of north central Columbia River drainage, in particular, young chinook salmon and steelhead trout. Wash. Dept. Fish. Biol. Rep. 37-A:1-14.

EPA (U.S. Environmental Protection Agency). 2000. National management measures to control nonpoint source pollution from marinas and recreational boating. Draft document prepared by Tetra Tech, Incorporated (Fairfax, VA) for Edwin F. Drabkowski, Nonpoint Source Control Branch, Office of Water, U.S. Environmental Protection Agency. Washington, DC. June 2000.

FWS (U.S. Fish and Wildlife Service). 1995. Sacramento-San Joaquin Delta Native fishes Recovery Plan. FWS, Portland, OR.

FWS (U.S. Fish and Wildlife Service). 1998. Central Valley Project Improvement Act Tributary Production Enhancement Report. Draft report to Congress on the feasibility, cost, and desirability of implementing measures pursuant to subsections 3406(e)(3) and (e)(6) of the Central Valley Project Improvement Act. FWS, Central Valley Fish and Wildlife Restoration Program Office, Sacramento, CA.

Hatton, S. R. 1940. Progress report on the Central Valley fisheries investigations, 1939. California Fish and Game 26: 334-373.

Healey, M.C. 1991. Life history of chinook salmon. *In* C. Groot and L. Margolis: Pacific Salmon Life Histories. University of British Columbia Press. pp. 213-393.

Kano, R. M. 1996. Annual report: chinook salmon spawning stocks in California's Central Valley, 1984. California Department of Fish and Game, Inland Fisheries division, Admin. Report No. 96-3. 40pp.

Kano, R.M. 1998. Annual report: chinook salmon spawning stocks in California's Central Valley, 1981. California Department of Fish and Game, Inland Fisheries division, Admin. Report No. 98-8. 40pp.

Kjelson, M.A., P.F. Raquel, and F. W. Fisher. 1982. Life history of fall-run juvenile chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento-San Joaquin estuary, California, p. 393-411. In: V.S. Kennedy (ed.). Estuarine comparisons. Academic Press, New York, NY.

Kondolf, G. M., J. C. Vick and T. M. Ramirez. 1996a. Salmon spawning habitat on the Merced River, California: An evaluation of project planning and performance. Trans. Amer. Fish. Soc. 125:899-912.

Kondolf, G. M., J. C.. Vick and T. M. Ramirez. 1996b. Salmon spawning habitat rehabilitation in the Merced, Tuolumne, and Stanislaus Rivers, California: An evaluation of project planning and performance. University of California Water Resources Center Report No. 90, ISBN 1-887192-04-2, 147pp.

Lister, D. B. and H. S. Genoe. 1970. Stream habitat utilization by cohabiting underyearlings of (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*) salmon in the Big Qualicum River, British Columbia. J. Fish. Res. Board Can. 27:1215-1224.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T. C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Of Commerce, NOAA Tech Memo. NMFS-NWFSC-35, 443p.

NMFS (National Marine Fisheries Service). 1997. Proposed recovery plan for the Sacramento River winter-run chinook salmon. NOAA Fisheries, Southwest Region, Long Beach, California. 288 p. plus appendices.

NMFS (National Marine Fisheries Service). 1998. Endangered and threatened species: Proposed endangered status for two chinook salmon ESUs and proposed threatened status for five chinook salmon ESUs; proposed redefinition, threatened status, and revision of critical habitat for one chinook salmon ESU; proposed designation of chinook salmon critical habitat in California, Oregon, Washington, Idaho. Federal Register 63 (45): 11482-11520. March 9, 1998.

PFMC (Pacific Fishery Management Council). 1999. Description and identification of essential fish habitat, adverse impacts and recommended conservation measures for salmon. Amendment 14 to the Pacific Coast Salmon Plan, Appendix A. Portland, OR.

PFMC (Pacific Fishery Management Council). 2000. Review of 1999 ocean salmon fisheries. Portland, OR.

Reynolds, F. L., T. J. Mills, R. Benthin and A. Low. 1993. Restoring Central Valley streams: A plan for action. California Department of Fish and Game, Sacramento, CA. 129pp.

Rich, A. A. and W. E. Loudermilk. 1991. Preliminary evaluation of chinook salmon smolt quality in the San Joaquin Drainage. California Department of Fish and Game, Fresno CA. 76 pp.

Schaffter, R. G. Fish occurrence, size, and distribution in the Sacramento River near Hood, California during 1973 and 1974. Calif. Fish Game Anad. Fish Admin Rep. No. 80-3. 76pp.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher and P. B. Moyle. 1996. Historical and present distribution of chinook salmon in the Central Valley drainage of California. Pp. 309-362. IN: Sierra Nevada Ecosystem Project: Final report to congress, vol. III, Assessments, Commissioned Reports, and Background Information. Davis: University of California, Centers for Water and Wildland Resources.

Yoshiyama, R. M., F. W. Fisher and P. B. Moyle.1998. Historical abundance and decline of chinook salmon in the Central Valley region of California. N. Am. J. Fish. Manage. 18:487-521.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher and P. B. Moyle. 2000. Chinook salmon in the California Central Valley: an assessment. Fisheries 25(2):6-20.